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BIOLOGICAL EVALUATION OF SOUTHERN PINE BEETLE ON THE CADDO AND MENA RANGER DISTRICTS, OUACHITA NATIONAL FOREST

by

James D. Smith and Neil A. Overgaard[1/]

Abstract

A biological evaluation of southern pine beetle (SPB) infestations was conducted on approximately 262,000 acres of the Caddo and Mena Ranger Districts, Ouachita National Forest in Arkansas. During August 1982, the Caddo and Mena Ranger Districts had an estimated 35 active spots. A total 3,147 acres of susceptible host type is in SPB infested compartments on the districts. There are 11.6 SPB spots per M acres of host type in infested areas. Forest Pest Management recommends that a SPB suppression project be initiated on the Caddo and Mena Ranger Districts.

Introduction

A biological evaluation was conducted on the Caddo and Mena Ranger Districts (RD) of the Ouachita National Forest to determine the status of southern pine beetle (*Dendroctonus frontalis* Zimm.) populations. Entomologists from State & Private Forestry, Forest Pest Management (FPM), Alexandria, LA, Field Office conducted the evaluation on August 30 - September 2, 1982.

Southern pine beetle (SPB) infestations have been occurring sporadically on the Ouachita National Forest in Arkansas since the early 1960's. Since that time beetle populations have fluctuated between endemic and epidemic levels on various districts. The last major peak in SPB activity on the Caddo and Mena RD's took place in the summer of 1977 (Smith 1978). Historically, the Ouachita National Forest has not suffered as severe losses as other National Forests in Region 8.

Method of Evaluation and Analysis of SPB Infestation

Aerial Survey and Ground Checks

Standard aerial sketch map procedures were used for this evaluation, except survey coverage was 100 percent. The aerial survey was conducted by district

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[1/] Entomologists, USDA Forest Service, Southeastern Area, State & Private Forestry, Forest Pest Management, Pineville, LA.

personnel in August 1982, and spots of red and/or fading trees were recorded and plotted on Forest Service Class A maps. Spots were selected for ground checking on the basis of their accessibility.

Numbers of vacated and infested trees, basal area, age, height, percentage of the stand in sawtimber, and landform were recorded. This information was used to run the benefit/cost analysis and to hazard rate the stands.

Hazard Rating

All the SPB infested stands were hazard rated at the time of ground checking. This is part of FPM's effort to validate SPB hazard rating systems whenever the opportunity exists. The system used was developed by Dr. Timothy Ku of the University of Arkansas at Monticello. It is designed for use on forests in Arkansas and utilizes field data collected during the ground checking procedure.

Suppression Project Criteria

Decisions to initiate a SPB suppression project were based on the following criteria:

-Number of active SPB spots per 1,000 acres of susceptible host type

This figure provides an indication of current levels of SPB activity. Historically, 1 active multiple tree spot/1,000 acres of susceptible host type has been considered the lower threshold of a SPB epidemic. However, 1 or more spots/1,000 acres of susceptible host type do not always require that a SPB suppression project be undertaken. This is the case when the majority of the spots are small, involving minimal timber losses, and individual spots are likely to go inactive. To determine the number of acres of susceptible host type, the Continuous Inventory of Stand Conditions (CISC) data for the Ouachita National Forest, Caddo and Mena Districts, were accessed and number of acres of shortleaf-oak, loblolly, shortleaf, red oak-yellow pine, white oak-yellow pine, and northern red oak-hickory-yellow pine were determined (forest type codes 12, 31, 32, 44, 47, and 48). Regeneration, seedling-sapling and sparse stand, acreage was subtracted from the total as these areas have little chance of sustaining large losses to SPB.

-Green tree:red tree ratio

This ratio, based on the number of green infested trees to the number of red and fading infested trees, provides an indication of how rapidly a SPB spot is expanding at the time of ground check.

-Additional timber loss in each spot for the 30 day period following ground check

A formula developed by Billings and Hynum (1980) was used to predict additional timber loss during the 30 day period following ground checks. This formula uses total basal area (TBA), and number of trees infested at the initial visit (IAT) to predict additional

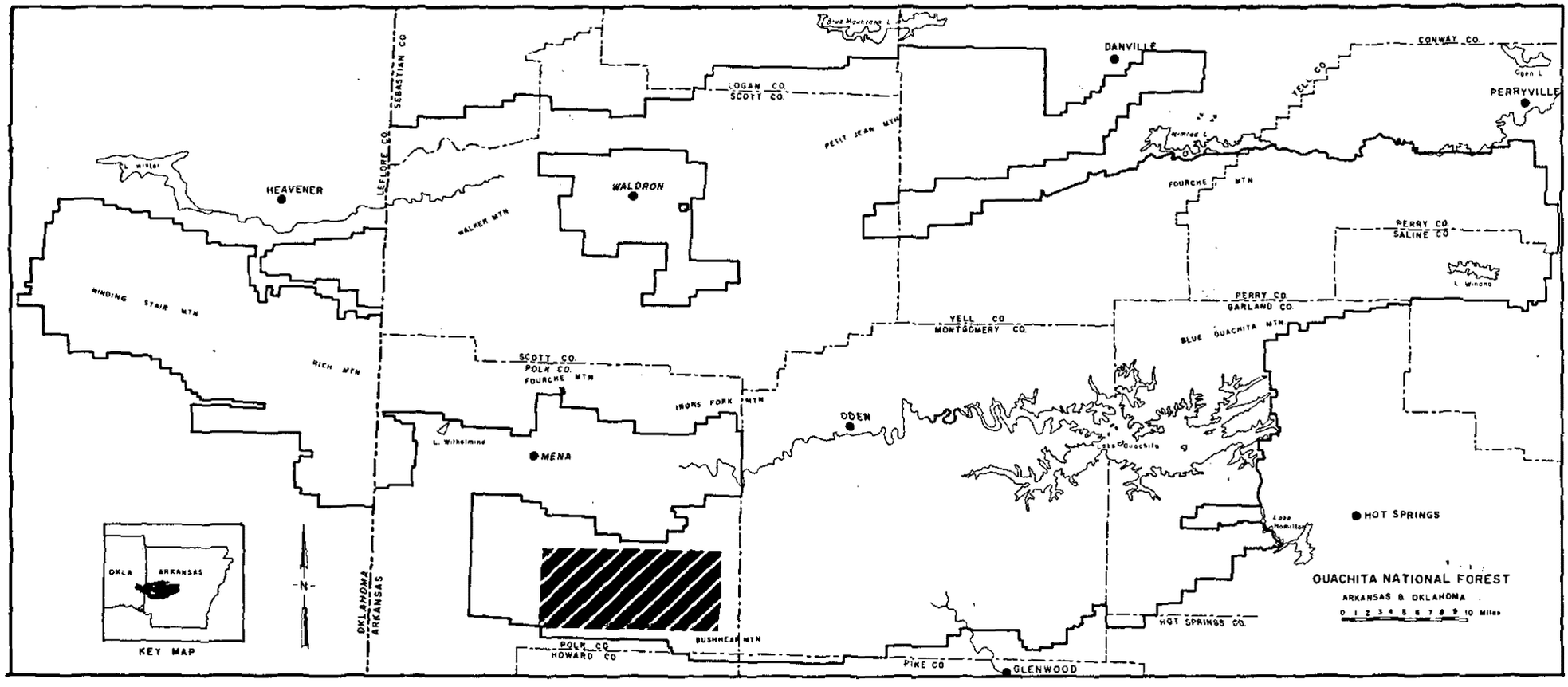
Table 1. Summary of ground check data for the Mena and Caddo Ranger Districts, Ouachita National Forest, August 1982.

Spot No.	Total No. Trees	No. Infested Trees			No. Vacated Trees	% Infested	Green:Red Ratio[a/]	Additional Spot Growth Loss[b/]	Age	Total Basal Area
		Total	Green	Red	Total					
1	138	88	61	27	50	64	2.3:1	68	62	140
2	74	29	26	3	45	39	8.7:1	25	56	180
3	70	40	22	18	30	57	1.2:1	18	44	100
4	7	7	3	4	0	100	.75:1	1	55	180
5	3	2	1	1	1	67	1.0:1	0	55	120
6	153	91	76	15	62	59	5.1:1	82	52	160
7	581	202	179	23	379	35	7.8:1	177	56	150
8	58	22	0	22	36	38	0.0:1	14	64	150
9	3	2	2	0	1	67	2.0:1	0	62	110
TOTAL	1,087	483	370	113	604	-	-	385	-	-
MEAN	121	54	41	13	67	58	3.2:1	43	56	143

a/ Based on infested trees only.

b/ Additional number of trees lost over 30 days during summer months. Based on formula ATK = [(0.000202 IAT x TBA) - 0.2211] x 30 (Billings and Hynum 1980).

Figure 1. Location of SPB infestations on the Caddo and Mena Ranger Districts, Ouachita National Forest.



Area infested with SPB

trees killed in a 30 day period (ATK). The number of spots showing additional timber loss and the size of this loss are used to provide an indication of whether SPB losses will continue. Even if a large number of SPB spots occur on a district they are relatively unimportant if additional timber losses are small.

-Volume of timber currently infested and economic evaluation

The volume of timber currently infested is calculated from the ground checked SPB spots. The currently infested volume is used in the Southern Pine Beetle Economic Evaluation Program (SPBEEP) to develop the economic benefit cost ratio, internal rate of return, targets for timber to be removed, and the volume of timber protected by control efforts. As the volume of timber currently infested with SPB increases, the economic benefits from a SPB suppression project also increase.

-Entomological judgment

Professional experience and field observations from the ground checked spots are used to interpret and supplement the technical data to reach a final decision.

Results and Discussion

A total of 35 multiple tree SPB spots were recorded during the aerial survey. Ground checks by district personnel determined that all spots were actively infested by SPB. Nine spots were ground checked by FPM during the evaluation and the data are summarized in table 1. The ground checked spots ranged in size from 3-581 trees (mean spot size was 54 active trees) and the mean ratio of green infested trees:red infested trees was 3.3:1. Most of the spots were rapidly expanding and contained many trees with fresh attacks.

Figure 1 shows the area of heaviest SPB activity. There is a total of 128,757 acres of susceptible host type for the Caddo and Mena RD's which gives a mean 0.3 SPB spots/1,000 acres of susceptible host type. However, if only the acres within the compartments in the area of heaviest infestation are considered, the acreage of susceptible host type is reduced to 3,147 and the ratio increases to 11.6 SPB spots/1,000 acres of susceptible host type. This is more indicative of the epidemic conditions that were encountered in the outbreak area.

CANEY CREEK WILDERNESS AREA

The Caney Creek Wilderness Area is a contiguous part of the Mena RD. This area was aerially surveyed in March (Dull 1982), July, and in August 1982 by Forest Pest Management and district personnel. The area was also evaluated by Nettleton and Overgaard during April 1982. At that time no control action was recommended. There are presently a minimum of five SPB

Table 2. SPB hazard rating summary for infestation locations, Caddo and Mena Ranger Districts, Ouachita National Forest, August 1982.

Spot No.	Total Basal Area	Pine Basal Area	Radial Growth Last 10 Years (in.)	Diameter (in.)	Age	Pine Species	Hazard Rating
1	140	100	.8	12	62	Shortleaf	Medium
2	180	150	.7	14	55	Shortleaf	High
3	100	80	.7	14	44	Shortleaf	Medium
4	180	140	.8	15	56	Shortleaf	Medium
5	120	100	.6	10	55	Shortleaf	Medium
6	160	100	.8	14	52	Shortleaf	Medium
7	150	120	.7	12	64	Shortleaf	Medium
8	150	100	.6	15	56	Shortleaf	Medium
9	110	60	.7	12	60	Shortleaf	Low

spots within the Wilderness Area. Four of these SPB spots within the Wilderness Area threaten adjacent managed timber, public and private. These SPB spots have now grown from an estimated 20, 20, 50, and 10 trees per spot found in the aerial survey of July 20-21, 1982 (Dull 1982) to approximately 250 trees each (aerial survey September 7, 1982; personal communication with RTW Staff, Ouachita NF) and are still expanding. SPB infestations on the periphery of the Wilderness Area have a green to red infested ratio of 3.3:1. SPB infestations within the Wilderness Area have a high probability of exhibiting this kind of ratio as indicated by the increase in aerial estimates, of spot size, between July 20 and September 7, 1982.

Trend

Of the 9 spots ground checked 6 were predicted to have substantial additional timber loss during the 30 day period following ground checking (table 1). The range in predicted spot growth was from 0 to 177 trees with a mean of 43 trees.

Economic Analysis

The estimated volume of trees currently infested is 2,180 MBF. If a SPB suppression project were undertaken it is estimated that 1,141 MBF would be removed and 1,795 MBF of timber would be protected. For detailed information on the economic benefits with and without a project refer to Appendix I.

Hazard Rating

Eight of the 9 infestations rated as high or medium risk to SPB attack. Ku et al. 1979, found in Arkansas that the majority of large SPB infestations occurred in shortleaf pine stands that were immature sawtimber or poletimber, or slow growing, and well stocked. This is true of the ground checked spots on the Caddo and Mena RD's as table 2 demonstrates.

Recommendations

CADDO AND MENA RANGER DISTRICTS

Based on the number of SPB spots/1,000 acres of susceptible host type in the outbreak area, the ratio of green infested to red infested trees, the large spot size, predictions for additional losses and the economic analysis, FPM recommends a suppression project for the Caddo and Mena RD's. We recommend using primarily the salvage and cut-and-leave techniques for spot suppression. A detailed description of these and other control alternatives is addressed in Appendix II. This control action can be compromised, however, if SPB infestations inside the adjacent Caney Creek Wilderness Area are left untreated.

Due to the large number of spots needing treatment we also recommend using the Southern Pine Beetle Fact Sheet No. 3 (Anonymous 1979) or Texas Forest Service Circular 249 (Billings and Hynum 1980) to establish spot priorities for control.

Forestry Bulletin SH-FB P

October 1979

United States Department of Agriculture
Forest Service

FOREST INSECT AND DISEASE MANAGEMENT

Technology Update

Southeastern Area, State and Private Forestry, 1720 Peachtree Road, N.W., Atlanta, Ga. 30309

Southern Pine Beetle Fact Sheet
Number 3

SETTING CONTROL PRIORITIES FOR THE SOUTHERN PINE BEETLE*

All southern pine beetle spots (groups of infested trees) do not have the same control priority. The following guidelines should help you set priorities for controlling individual spots.

A. Classify the infested trees according to the stage of attack shown below.

Symptom	Stage 1 Fresh attacks	Stage 2 Developing broods	Stage 3 Vacated trees
Foliage	Green	Green, trees with larvae; fade to yellow before new generation.	Red, needles falling.
Pitch tubes	Soft white, light pink,	White, hardened.	Hard, yellow, crumbles easily.
Checkered beetles	Adults crawl on the bark.	Larvae in SPB galleries; pink or red; 1/2 inch long.	Larvae and pupae are purple; occur in pockets in the outer bark.
Bark	Tight, hard to remove.	Loose, peels easily.	Very loose, easily removed.
Color of wood surface	White, except close to new adult galleries.	Light brown with blue or black sections.	Dark brown to black, may have sawyer galleries.
Exit holes	----	May appear where parent beetles left the tree.	Numerous
Ambrosia beetle dust	---- ----	White, begins to appear around the base of trees.	Abundant at the base of trees.

*Compiled from a handbook of the Texas Forest Service. It will be published this fall by the USDA's Expanded Southern Pine Beetle Research and Applications Program.

B. Collect spot expansion data:

1. Walk completely around the spot and look for stage 1 trees, which indicate the area of most recent beetle activity. Areas with stage 1 pines are called "Active heads." Check to see if the spot is expanding in more than one direction. Large spots can have more than one active head.

2. Determine the number of stage 1 and 2 trees. For large spots that have more than 50 trees, it is not necessary to examine each tree. Just walk the boundaries and estimate the number of these trees in the spot.

3. From a location about 20 feet (6 m) in front of the active head(s), determine the pine basal area (a measure of stand density) in square feet per acre. A 10-factor prism is useful for this purpose.

4. Note whether most trees in the spot are pulpwood (less than 9 inches in diameter) (23 cm) or sawtimber size (more than 9 inches in diameter).

5. If only stage 3 trees are present, control is not necessary.

6. Determine the control priority for the spot, using the guide on the next page (item C).

C. Guide to southern pine beetle control priorities (May through October):

Key to spot growth	Your spot's classification	risk-rating points
A. Stage 1 trees	absent	0
	present	30
B. Stage 1 and 2 trees	1 to 10	0
	11 to 20	10
	21 to 50	20
	more than 50	40
C. Pine basal area (ft^2/a) or stand density at active head or heads	less than 80 (low density)	0
	80 to 120 (medium density)	10
	more than 120 (high density)	20
D. Stand class by average d.b.h. (in inches)	pulpwood (9 inches or less)	0
	sawtimber (more than 9 inches)	10

	Buffer strip width (feet)
If total is: 70 to 100.....control priority is: High	40 to 100
If total is: 40 to 60.....control priority is: Medium	10 to 40
If total is: 0 to 30.....control priority is: Low	10 to 40

CANEY CREEK WILDERNESS AREA

We also recommend that the larger SPB spots; those with >100 active trees, in the Caney Creek Wilderness Area be treated first with the cut-and-leave technique. Other SPB infestations inside the Wilderness Area with more than 10 infested trees and with more green trees than red trees infested (a growing spot) can be treated as time and manpower permit. A ground check of all treated areas should be made two to three weeks after treatment. This is to ensure that the treatment has been successful and no breakouts have occurred. The cut-and-leave method is specially suited to this kind of area since no heavy equipment need enter the area and no pesticide needs to be applied.

Aerial surveys during the spring of 1983 should be made monthly to monitor the success of the control tactic or the resumption of spot growth or spot proliferation. If breakouts occur after September 30 and before May 1, then a treatment alternative <u>other</u> than cut-and-leave must be chosen.

The majority of all active SPB infestations on both the Caddo and Mena RD's are on the periphery of the Caney Creek Wilderness Area. Proliferation of SPB spots in present infestations and initiation of new infestations in adjacent areas may be expected to continue until a natural phenomenon or control efforts by man disrupt the present population.

APPENDIX I

Table 3. *Southern pine beetle economic evaluation and timber targets for the Caddo Ranger District.*

WITHOUT A PROJECT

AGE	HARV OBJ.	VOLUME LOST (MBF)	SPOT GROWTH RATE	VOLUME THREAT (MBF)	GROWTH RATE (%)	AGE AT HARV.	VOLUME AT HARVEST (MBF)	PRICE AT HARV.	VALUE AT HARVEST	PRESENT VALUE
60	S/F	656	2.53	1660	.7	70	1801	$ 150	$ 270155	$ 175488
TOTAL		656		1660			1801		$ 270155	$ 175488
								VALUE OF THE VOLUME NOT SALVAGED (LOST)		$ 42652
								TOTAL VALUE LOST		$ 218139

WITH A PROJECT

AGE	HARV OBJ.	VOLUME LOST (MBF)	SPOT GROWTH RATE	VOLUME THREAT (MBF)	GROWTH RATE (%)	AGE AT HARV.	VOLUME AT HARVEST (MBF)	PRICE AT HARV.	VALUE AT HARVEST	PRESENT VALUE
60	S/F	187	2.53	474	.7	70	515	$ 150	$ 77187	$ 50139
TOTAL		187		474			515		$ 77187	$ 50139
								VALUE OF THE VOLUME NOT SALVAGED (LOST)		$ 12186
								TOTAL VALUE LOST		$ 62326

TARGETS

VOLUME REMOVED:	750
VOLUME PROTECTED:	1186

Table 4. Southern pine beetle economic evaluation and timber targets for the Mena Ranger District.

WITHOUT A PROJECT

AGE	HARV OBJ.	VOLUME LOST (MBF)	SPOT GROWTH RATE	VOLUME THREAT (MBF)	GROWTH RATE (%)	AGE AT HARV.	VOLUME AT HARVEST (MBF)	PRICE AT HARV.	VALUE AT HARVEST	PRESENT VALUE
60	S/F	343	2.49	854	.7	70	926	$ 150	$ 138901	$ 90228
TOTAL		343		854			926		$ 138901	$ 90228

VALUE OF THE VOLUME NOT SALVAGED (LOST) $ 22263

TOTAL VALUE LOST $ 112491

WITH A PROJECT

AGE	HARV OBJ.	VOLUME LOST (MBF)	SPOT GROWTH RATE	VOLUME THREAT (MBF)	GROWTH RATE (%)	AGE AT HARV.	VOLUME AT HARVEST (MBF)	PRICE AT HARV.	VALUE AT HARVEST	PRESENT VALUE
60	S/F	98	2.49	244	.7	70	265	$ 150	$ 39686	$ 25779
TOTAL		98		244			265		$ 39686	$ 25779

VALUE OF THE VOLUME NOT SALVAGED (LOST) $ 6361

TOTAL VALUE LOST $ 32140

TARGETS

VOLUME REMOVED:	391
VOLUME PROTECTED:	610

Table 5. Southern pine beetle economic evaluation for the Ouachita National Forest at 4% discount rate.

WITHOUT A PROJECT

AGE	HARV OBJ.	VOLUME LOST (MBF)	SPOT GROWTH RATE	VOLUME THREAT (MBF)	GROWTH RATE (%)	AGE AT HARV.	VOLUME AT HARVEST (MBF)	PRICE AT HARV.	VALUE AT HARVEST	PRESENT VALUE
60	S/F	999	2.52	2514	.7	70	2727	$ 150	$ 409057	$ 265715
TOTAL		999		2514			2727		$ 409057	$ 265715

VALUE OF THE VOLUME NOT SALVAGED (LOST) $ 64915

TOTAL VALUE LOST $ 330630

WITH A PROJECT

AGE	HARV OBJ.	VOLUME LOST (MBF)	SPOT GROWTH RATE	VOLUME THREAT (MBF)	GROWTH RATE (%)	AGE AT HARV.	VOLUME AT HARVEST (MBF)	PRICE AT HARV.	VALUE AT HARVEST	PRESENT VALUE
60	S/F	285	2.52	718	.7	70	779	$ 150	$ 116873	$ 75919
TOTAL		285		718			779		$ 116873	$ 75919

VALUE OF THE VOLUME NOT SALVAGED (LOST) $ 18547

TOTAL VALUE LOST $ 94466

PROJECT BENEFITS:	236164
TOTAL PROJECT COST:	21053
NET PRESENT VALUE:	215111
BENEFIT COST RATIO:	11.22
INTERNAL RATE OF RETURN:	> 400%
COMPOSITE RATE OF RETURN:	29.56%
TARGETS	
VOLUME REMOVED:	1141
VOLUME PROTECTED:	1795

Table 6. Southern pine beetle economic evaluation for the Ouachita National Forest at 7.12 % discount rate.

WITHOUT A PROJECT

AGE	HARV OBJ.	VOLUME LOST (MBF)	SPOT GROWTH RATE	VOLUME THREAT (MBF)	GROWTH RATE (%)	AGE AT HARV.	VOLUME AT HARVEST (MBF)	PRICE AT HARV.	VALUE AT HARVEST	PRESENT VALUE
60	S/F	999	2.52	2514	.7	70	2727	$ 150	$ 409057	$ 191958
TOTAL		999		2514			2727		$ 409057	$ 191958
								VALUE OF THE VOLUME NOT SALVAGED (LOST)		$ 64915
									TOTAL VALUE LOST	$ 256873

WITH A PROJECT

AGE	HARV OBJ.	VOLUME LOST (MBF)	SPOT GROWTH RATE	VOLUME THREAT (MBF)	GROWTH RATE (%)	AGE AT HARV.	VOLUME AT HARVEST (MBF)	PRICE AT HARV.	VALUE AT HARVEST	PRESENT VALUE
60	S/F	285	2.52	718	.7	70	779	$ 150	$ 116873	$ 54845
TOTAL		285		718			779		$ 116873	$ 54845
								VALUE OF THE VOLUME NOT SALVAGED (LOST)		$ 18547
									TOTAL VALUE LOST	$ 73392

PROJECT BENEFITS:	183481
TOTAL PROJECT COST:	21053
NET PRESENT VALUE:	162428
BENEFIT COST RATIO:	8.72
INTERNAL RATE OF RETURN:	> 400%
COMPOSITE RATE OF RETURN:	30.43%
TARGETS	
VOLUME REMOVED:	1141
VOLUME PROTECTED:	1795

Appendix II

ALTERNATIVES FOR SOUTHERN PINE BEETLE CONTROL

Four alternatives are recommended for southern pine beetle control. The following discussion briefly outlines these alternatives (Swain & Remion 1980). For a more detailed description on conducting control procedures in a southern pine beetle suppression project refer to the Project Control Plan.

Alternative 1. Remove trees through salvage.

Salvage is the method most often used for stopping the growth of existing spots. This strategy involves removing a buffer strip of noninfested trees, all green infested and red infested trees, and if desired, the trees already killed by the beetles. Costs associated with removing uninfested trees are not charged to specifically designated SPB Project Control Funds since removing uninfested material is not needed for successful control even though it may be operationally desirable. The buffer strip should surround the recently attacked trees. It should be 40 to 70 feet wide for most active spots, while a 100-ft strip (and occasionally larger) may be needed for large, rapidly expanding spots. As a rule, the width of the buffer should not exceed the average height of the trees in the spot. The SPB spot should be carefully surveyed and all trees to be removed should be marked.

To implement this alternative the buffer strip should be cut first. All infested trees should then be cut. Vacated trees are cut last and are removed only for utilization purposes. All trees should be felled toward the center of the spot. The reason for this is to keep infested trees as far away from noninfested trees as possible. This reduces the chance of beetles killing additional trees.

Alternative 2. Piling and burning.

Unmerchantable or inaccessible southern pine beetle infestations can be suppressed by cutting, piling, and thoroughly charring the bark of infested trees. The entire bark surface must be thoroughly charred to insure effective control. The order of priority for cutting, piling, and burning infested trees, particularly in large spots, is the same for Alternative 1. Cutting a buffer strip is not recommended. To reduce the possibility of "breakouts", every effort should be made to locate and treat all green infested trees during the piling and burning operation.

Alternative 3. Cut-and-leave infested trees.

This is accomplished by felling a buffer strip and all infested trees toward the center of the spot. The purpose is to stop spot growth. Use of this method causes beetles to disperse at a time of year when this behavior is unnatural. This results in a reduction of mass attacked trees and spot growth ceases. Cut-and-leave should only be used in the summer (May 1 - September 30), since these are the only months beetles are not dispersing. It should only be used on small spots, normally 50 infested trees or less.

The conditional statement for number of trees treated is expanded in wilderness areas, where, due to lack of management alternatives, cut-and-leave must be used on larger spots. Treating spots larger that 50 active trees has been successful in Texas, Mississippi, and Alabama.

Alternative 4. Chemically treat infested trees.

In this method, infested trees are felled toward the center of the spot, cut into workable lengths, and sprayed with lindane or Dursban® 4E. The purpose of this method is to kill the beetle population. To be effective, all bark surfaces must be sprayed. This involves turning the logs which becomes more difficult as tree size increases.

Forest Pest Management, Alexandria Field Office, Pineville, LA, should be contacted prior to the extensive use of chemical control for an update on latest restrictions or application procedures.

Alternative 5. No action.

No action is an alternative to use when for economic, or aesthetic reasons, a project cannot be undertaken successfully. Wilderness areas are many times left to evolve naturally without man's interference.

PRECAUTIONARY STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in their original containers under lock and key out of reach of children and animals, and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear appropriate protective clothing.

If your hands become contaminated with a pesticide, wash them immediately with soap and water. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove the clothing immediately and wash skin thoroughly. After handling or spraying pesticides, do not eat or drink until you have washed with soap and water.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicide from equipment, do not use the same equipment for insecticides or fungicides that you used for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary landfill dump, or crush and bury them in a level, isolated place.

NOTE: Some states have restrictions on the use of certain pesticides. Check your state and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your county agent, state extension specialist or FPM to be sure it is still registered for the intended use. For further information or assistance, contact Forest Pest Management, Alexandria Field Office, Pineville, La., 71360, (Telephone: FTS 497-7280, or Commercial 318/473-7280).

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